EYEGLASS ASSEMBLY AND FASTENING ARRANGEMENT FOR ASSEMBLY THEREOF

FIELD OF THE INVENTION

This invention relates to a fastening arrangement for assembling a component to a lens.

BACKGROUND OF THE INVENTION

In the assembly of eyeglasses and eyeglass accessories (such as auxiliary lenses) it is necessary to join components to the lenses thereof. These components can be, for example, clips that attach to auxiliary lenses such as radiation filtering lenses, or the components can be temple-arms or nose-pieces for attaching to eyeglass lenses such as those of prescription eyeglasses or sun-glasses.

U.S. Patent No. 5,889,574 discloses a typical eyeglass clip-on accessory consisting of a pair of rimless non-optical lenses joined together by a bridge, the lenses having clips fastened thereon to engage the frame of eyeglasses. The clips are attached to the lenses by screws.

U.S. Patent No. 6,234,628 describes a pair of clip-on sunglasses whose lenses are in a frame having L-shaped plastic prongs to couple the clip-on onto the frame of spectacles.

U.S. Patent No. 5,724,118 describes a clip-on having lenses mounted in rings to which hooks are cemented or welded for connecting the clip onto the frame of spectacles.

U.S. Patent No. 6,089,706 describes a clip-on whose lenses are held in a wire frame. A wire passes through hooks to attach the clip-on to the frame of eyeglasses.

U.S. Patent No. 6,254,232 describes spring-biased clamping arms which act to clamp a clip onto the frame of eyeglasses.

U.S. Patent No. 6,116,731 describes a connection between sunglasses and optical eyeglasses by means of plug-in projections. U.S. Patent No. 6,196,679 discloses a similar connection.

U.S. Patent No. 5,694,192 discloses a clip-on whose coupling clips are joined to lenses by a tension thread.

U.S. Patent No. 6,244,704 describes such a clip to filter-lens attachment using welding.

SUMMARY OF THE INVENTION

The present invention generally relates to an eyeglass assembly and a fastening arrangement for assembly thereof. The fastening arrangement is used for assembling a component, e.g. a clip, to a lens such as described, for example, in Applicant's U.S. Patent No. 6,607,270.

The term *lens* or *lenses* as used herein refers to any lens including auxiliary lenses (such as those of an eyeglass clip accessory, e.g. a sunglass clip-on, or lenses having optical properties so that when it is placed in front of an optical lens they combine therewith to form a compound lens for visual correction) as well as prescription eyeglass lenses and non-prescription eyeglass lenses (such as safety lenses and sunglass lenses, etc.).

The invention is particularly useful for fastening a clip component of a clip-on accessory to an auxiliary lens such as a sunglass lens which is commonly clipped to a pair of prescription eyeglasses. Therefore, the invention will be primarily described in this context although the component could be any other member, e.g. a temple arm or nose piece to be attached to an optical lens of frameless eyeglasses or sunglasses.

According to one aspect of the present invention, there is provided a fastening arrangement for use with a curved lens having a first face, a second face and a bore passing between them and having a longitudinal axis slanted to the lens's

faces, for attaching to the lens a component at the first face of the lens; the fastening arrangement comprising a fastener having a lens-face engaging portion adapted to engage the second face of the lens and a component engaging portion entering the bore at the second face, and further comprising a fastener engaging portion in the component adapted to engage the component engaging portion of the fastener; all the engaging portions being designed so that when the component and curved lens are assembled, the lens-face engaging portion is oriented along the second face; and an eyeglass assembly comprising such a fastening arrangement.

According to one embodiment of the present invention, the component engaging portion of the fastener and the fastener engaging portion of the component are not threaded, with the lens-face engaging portion being is slanted relative to its component engaging portion. In this case, the fastener may be a pin having a head and a stem, with the head having a slanted bottom surface. Alternatively, the fastener may have a wedge-shaped portion, integrally or non-integrally to the head.

According to another embodiment of the present invention, the lens-face engaging portion of the fastener is not slanted relative to its component engaging portion, rather the fastener engaging portion of the component is slanted with respect to the axis of the bore so that its axis is perpendicular to the corresponding face of the lens. In this case, the fastener may be either threaded or not threaded.

According to yet another embodiment of the present invention the fastening arrangement comprises a diskette or ring whose bottom surface constitutes the lens-face engaging portion of the fastener. The ring is adapted to align the fastener with the bore and to interface with the lens-face with its lens-face engaging portion. This ring may be integrally formed with the component or a separate piece.

According to a further embodiment of the previous invention, the fastening arrangement wherein the component comprises a lens interfacing surface with a spherically shaped portion which interfaces with the bore to ensure full contact therebetween, when the fastener engaging portion of the component engages the component engaging portion of the fastener.

The arrangement of the present invention in which the lens-face engaging portion of the fastener is aligned with the lens's corresponding face has a plurality of advantages including the following:

- Stress applied to the lens during assembly is minimized.
- Different components are easily attached to the lenses.
- The components can interface with the lens's face to which they are attached even if this face is curved.
- The chance for the assembly loosening or coming apart is reduced.
- The clips and lenses can be mass-produced at relatively low cost.

According to another aspect of the present invention, there is provided a fastening arrangement comprising a fastening arrangement for assembly of a component to a lens, the lens having an edge and the component being L-shaped and having a ledge formed with a fastener engaging portion and a leg having a lens-edge interfacing portion, wherein the edge of the lens and the lens-edge interfacing portion of the component have inter-engaging parts to minimize movement between the lens and the component.

Typically, the inter-engaging parts are outside the edge of the lens and so both the field of vision of the wearer and the aesthetic virtues of the clip-on and lens are not be affected by the presence of the clips and inter-engaging parts.

According to another aspect of the present invention, there is provided a fastening member for use in attaching a component to a lens, the lens having a through bore and the component comprising a fastener engaging portion and being adapted for the attachment to the lens at the bore via a fastener having a component engaging portion, the component further comprising a spherically shaped portion which interfaces with the bore to ensure full contact therebetween, when the fastener engaging portion of the component engages the component engaging portion of the fastener.

When a threaded fastener is used in such a fastening arrangement, it is very important that it is tightened to an extent for reliably holding the assembly together while avoiding excessive stress on the lens material and the clip.

Therefore, according to a further aspect of the present invention, the fastening arrangement for assembly of a component to a lens comprises a bore passing therethrough; the fastening arrangement comprising a threaded fastener entering the bore and a fastener engaging portion, wherein the fastener comprises an arm connected therewith via a neck and designed to disconnect therefrom at the neck at a predetermined fastening torque upon the inter-engagement between the fastener and the fastener engaging portion.

By one embodiment of the present invention, this arrangement may further comprise a tool adapted for engaging the arm for ease of and reliability of assembly with use of the appropriate fastening torque.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

Fig. 1 is an illustration of a prior art arrangement for attaching a component to a lens;

Fig. 2A is a cross-sectional view of a fastening arrangement for attaching a component to a lens according to an embodiment of the present invention, in which the arrangement comprises a fastener with a slanted lens-face engaging portion;

Fig. 2B is a cross-sectional view of a modification of the fastening arrangement of the embodiment of Fig. 2A;

Fig. 2C is a cross-sectional view of another modification of the fastening arrangement of the embodiment of Fig. 2A;

Fig. 3 is a cross-sectional view of a fastening arrangement according to another embodiment of the present invention, in which the component has a slanted fastener engaging portion;

Fig. 4A is a cross-sectional view of a fastening arrangement according to yet another embodiment of the present invention, in which the arrangement comprises a lens-face engaging portion in the form of a ring;

Fig. 4B is a top view of the ring of Fig. 4A.

Fig. 4C is a cross-sectional view of a modification of the embodiment of Fig. 4A, in which the ring is integrally formed with the component;

Fig. 5 is a cross-sectional view of a fastening arrangement according to still another embodiment of the present invention, in which the component comprises a spherical portion interfacing the lens;

Fig. 6 is a cross-sectional view of a fastening arrangement according to a further embodiment of the present invention;

Fig. 7A is a cross-sectional view of a fastening arrangement according to yet another embodiment of the present invention, in which the lens and the component further comprise inter-engaging portions to prevent rotation therebetween;

Fig. 7B is a view of Fig. 7A along the line A-A;

Fig. 7C illustrates a modification of the embodiment of Fig. 7A; and

Figs. 8A and **8B** illustrate a still further embodiment of the fastening arrangement of the present invention, wherein the fastener incorporates an arm for facilitating and controlling the fastening, and the arm has associated therewith a tool for engaging the arm.

DETAILED DESCRIPTION OF THE INVENTION

Applicants' U.S. Patent No. 6,607,270, incorporated herein by reference, describes clip-ons where fastening arrangements in accordance with all embodiments of the present invention may be advantageously used. Therefore, clip-ons will not be described herein in any detail, rather the emphasis will be on the description of embodiments of fastening arrangements of a component, particularly a clip, to a lens. As mentioned above, the same arrangements may be suitable for lenses other than auxiliary lenses and for components other than clips.

Referring now to Fig. **1**, a prior art fastening arrangement is shown illustrating one of the problems with such arrangements. In Fig. **1**, a lens **10** is shown having an inner face **12**, an outer face **14**, an edge **15** and a bore **16** formed therein, typically slightly inward of the edge of the lens. The faces **12** and **14** are

curved. A component **18** is attached to outer face **14** of the lens by a screw **17** inserted in the bore **16** and a nut **19** carried by the screw. The bore **16** has a longitudinal axis **L1** defining its orientation relative to the lens's faces. The bore **16** may be formed so that its axis **L1** is slanted relative to an axis **L2** normal to the lens's inner face **12** at the location of the bore, or it may be normal to the inner surface **12** of the lens, the former design being more common for lenses with curved faces, due to the conventional methods of lens production, as detailed herein-below.

The drilling of bores in lenses is typically performed by one of two methods, namely the so-called "radial" method or "parallel" method.

The "radial" method is less common and involves drilling holes (bores) in the lens in a direction that would pass through a virtual point located at the center of a circle defined by the curvature of the lens; thus the drilling extends radially from such a center point. In other words, the drilling is normal to the face of the lens, i.e. normal to a plane tangent to the face at the location of drilling. This method may involve complications connected with holding the lens in the right orientation as this might change from one hole to another depending on the shape of the lens and on the location of the hole with respect to the center of the virtual point.

A more common and convenient practice is referred to as "parallel drilling", where the lens is held in a so-called "horizontal position" and the drill bit is introduced to the lens vertically. The "parallel method" is the common practice of drilling holes or bores in lenses due to the low cost and simplicity. When bores are drilled in lenses using the "parallel method", the resultant bores are parallel to each other and not perpendicular to the face of the curved lens.

Reverting to Fig. **1**, when the lens **10** and the component **18** are assembled by means of the screw **17** and nut **19** at the slanted bore **16**, an excessive force is applied at a point **S1** on the inner face **12** and a point **S2** on the outer face **14** of the lens **10**; as well as at a point **S3** on the component. Since this force is applied on a significantly small area, the stresses caused by the applied force can be extremely high. When a rigid material, such as glass or thermoplastic polymer, is exposed to

high stress, it may develop internal stresses resulting in crazing or cracking. This phenomenon is usually referred to as "stress concentration" and it is well known among those of the art.

Furthermore, the above fastening arrangement may also result in the premature loosening of the screw **17** and nut **19** and thus poor contact or even the disconnection of the screw and nut coupling.

Fig. **2A** shows a first embodiment of an eyeglass assembly and fastening arrangement for assembly thereof designed to minimize the stress concentration that may occur upon fastening a component, such as a clip, to a curved lens. The curved lens **10** comprises the slanted bore **16**, common in the production of such lenses as discussed above; the bore having the longitudinal axis **L1**. A component in the form of a clip **20** is shown aligned for fastening to the face **14** of the lens **10**, the clip having an L-shape with a leg **22** and a ledge **24**. The ledge **24** is formed with a slanted plug **26**, corresponding to the slanted bore **16**. The plug **26** has a cavity **28** constituting the clip's fastener engaging portion coaxial with the bore **16**. The slant of the bore **16** and the cavity **28** is defined by an angle **A1** between their longitudinal axis **L1** and an axis **L2** normal to the faces **12** and **14** of the lens **10**. It should be understood that since faces **12** and **14** are curved, axis **L2** is normal to these faces only in the area of the bore **16**.

The ledge **24** typically has a slight curve to correspond with the curve of the lens **10**, as made clearer by dashed line **T** which is tangent to the lens at the point where the lens has been bored.

Further seen in Fig. **2A** is a fastener in the form of a pin **30** having a head **32** with a bottom surface **34** constituting a lens-face engaging portion, and a component engaging portion in the form of a stem **36**. The head **32** has an axis **L3** which is normal to its bottom surface **34** and parallel to the lens faces' normal axis **L2**. The stem **36** has a longitudinal axis **L4** parallel to the axis **L1** of the cavity **28**. To compensate for the slant expressed by angle **A1**, the head **32** is slanted with respect to the stem **36** at an angle **A2** equal to the angle **A1**. Thus, when the pin **30** correspondingly engages the cavity **28** its head **32** interfaces with the inner face **12**

and is oriented along this face. This engagement reduces the possibility of high stress to the lens **10** since the planar bottom surface **34** of the head **32** is now essentially parallel to the lens' inner face **12**.

The head **32** of the pin **30** may have any shape although a configuration such as hex-shape may be advantageous for gripping. The plug **26** and the stem **36** are typically co-designed such that the stem snappingly engages with the cavity **28** in a male-female relationship.

It is noticed that the plug **26** is integrally formed with the clip's ledge **24** which eliminates the need for a nut (such as the nut **19** of prior art Fig. **1**).

Fig. **2B** illustrates a modification of the embodiment of Fig. **2A** wherein the male/female fastening relationship is switched. Thus, in this modification there is a component in the form of a clip **20a** comprising a ledge **24a** having a male plug **26a** with a cavity **28a** corresponding to a fastener in the form of a female pin **30a** having a head **32a** with a lens-face engaging portion in the form of a bottom surface **34a** and whose component engaging portion is in the form of a stem **36a**, typically cylindrical and having a suitably shaped hollow portion **37**. Other components and principles of the fastening arrangement are analogous to those of Fig. **2A**.

It should be understood that instead of the entire head of the pin being slanted, there could be a pin **30'** with an alternately shaped head **32'** comprising a wedge-shaped portion **39** to thereby orient its bottom surface **34'** along the lens' inner face **12**; as shown in Fig. **2C**.

Fig. **3** illustrates another embodiment of the present invention for fastening a clip to a lens involving minimal stress concentration in the lens, in which a fastener with a standard configuration may be used. In this embodiment, fasteners in the form of a screw, bolt, rivet, etc, as well as a pin are suitable.

The differences between the embodiments of Fig. **2A** and Fig. **3** are mainly in that there is a component in the form a clip **20b**, with a plug **26b** whose cavity **28b** has a longitudinal axis **L5** slanted with respect to the axis **L1** of the plug and the bore **16** so as to be parallel to the axis **L2**, and the cavity **28b** is adapted for receiving a fastener that is in the form of a screw **30b** (although a pin, bolt, rivet or

the like could also be used, *mutatis mutandis*). The slant of the cavity's longitudinal axis **L5** with respect to the longitudinal axis **L1** of the plug **26b** and the bore **16** (angle **A3**) compensates for the slant (angle **A1**) between the axis **L1** and the axis **L2** which is normal to the inner face **12**.

Thus, the screw **30b**, which has a stem **36b** constituting the component engaging portion and a head **32b** with a lens-face engaging portion in the form of a bottom surface **34b**, interfaces with the lens **10** such that the bottom surface is oriented along the inner face **12** thereof.

Figs. **4A** to **4C** illustrate other embodiments of the eyeglass assembly and fastening arrangement therefor having a related nature. Fig. **4A** relates a fastening arrangement wherein the fastener comprises a lens-face engaging member in the form of a diskette or ring **40**. The ring **40** is shown having a wedge-shaped profile which facilitates assembling a component in the form a clip **20c** to the lens **10** with minimal stress applied thereto.

The ring **40** has a lower surface **42** which is shaped to smoothly interface the lens's inner face **12**. The ring **40** also has an annular shoulder **44** which corresponds to the screw head's bottom surface **34b** and interfaces therewith upon fastening. The shoulder **44** is typically recessed to a depth **D** being larger than the height **h** of the screw head **32b** to prevent the screw **30b** from catching on material or on a wearer or assembly-person; as well as for aesthetic reasons.

In this arrangement, the clip **20c** comprises a ledge **24c** with a plug **26c** having a cavity **28c** that is co-axial to the plug and constitutes a fastener engaging portion of the clip **20c**. The fastener can be a standard screw though, as previously mentioned, a variety of fastener types could be used.

With the incorporation of the ring **40**, the fastening arrangement is such that the screw head **32b** has an axis **L4** coinciding with that of the stem **36b** and the cavity **28c**. Further, even though both the screw head **32b** and the stem **36b** are slanted with respect to axis **L2** (normal to the lens faces **12, 14**), there is an essentially even force applied to the lens **10** during fastening – thus, the stress applied thereto is minimized. Moreover, as the ring **40** has a larger surface area at

its lower surface **42** than the screw head's bottom surface **34b**, the pressure on the lens **10** is further reduced.

The ring **40** may also comprise a projection **46** designed to interface with the leg **22** of the clip **20c** to facilitate proper alignment and to prevent rotation thereof during fastening. The projection **46** typically interfaces an outside surface of the leg **22** and would therefore not be visible in a cross-sectional view, however, for explanatory purposes it is shown as if it is in the plane of the cross-section. The form and typical position of this projection **46** is better seen in Fig. **4B** which shows a top view of the ring **40** further illustrating its geometry including a through-bore **49**. Adjacent the projection **46** is a generally flat portion **48**, which may rest up against a corresponding portion of the leg **22** of the clip **20c**. This interface also helps properly position the ring **40** and limits rotation thereof. The ring **40** can be shaped to facilitate inserting the screw **30b** and is therefore illustrated as having a somewhat funnel-shaped recess above its shoulder **44**; and the ring can help align the screw.

Fig. **4C** shows a modification to the embodiment of Fig. **4A** wherein there is a component in the form a clip **20d** comprising a leg **22a** with a ring **40'** integrally attached thereto. The ring **40'** provides the same function as the ring **40** of Fig. **4A** although there is no projection **46**. It is noteworthy that the ring **40'** is not wedge-shaped. Regardless, its lower surface **42** still corresponds to the inner face **12**, with the shoulder **44** properly positioning the fastener.

Since the ring **40'** is integral with the clip's leg **22a**, it cannot move (slide or rotate) relative thereto and is mated properly with the lens's inner surface **12** and its through-bore **49** is aligned appropriately with the bore **16** as a result of proper manufacturing.

Fig. **5** illustrates yet another embodiment for a clip-to-lens fastening arrangement wherein there is a component in the form a clip **20f** with a ledge **24e** having a plug **26e** that comprises a spherically shaped portion **50**. The spherically shaped portion **50** interfaces with the bore **16** at the lens's outer face **14**. Dashed lines **51** illustrate that the component **20f** and the spherically shaped portion **50** may

be non-integral parts, although they may also be integrally formed. Furthermore, spherically shaped portion **50** may be in the form of only a partial sphere (e.g. hemi-sphere) with the stipulation that a spherical portion thereof interface with the bore **16**.

It is also noticed that the lens-engaging portion may be a ring **40'** which has an L-shaped projection **46'** designed to interface with the lens **10**.

Thus, even though the edge of the bore **16** is slightly elliptical due to the curvature of the lens **10**, as a result of the geometry of the spherically shaped portion **50** there is an even contact at the bore.

Fig. **6** illustrates a further embodiment wherein the fastening arrangement comprises a component in the form of a clip **20g** having a ledge **24g** comprising a fastener alignment portion **52** oriented parallely to the lens's inner face **12** and thus normal to axis **L2**. The portion **52** may have an integral fastener engaging portion such and therefor be threaded to suit a corresponding fastener.

Alternatively, or in addition, the fastener alignment portion **52** can comprise a surface **54** and be adapted to receive a fastener engaging portion in the form of a nut **56**. The nut **56** interfaces the surface **54** so as to be aligned with the fastener, screw **30b**, and to orient the nut **56**, so that the bottom surface **34b** of the screw if oriented along the lens's inner face **12**. This fastener alignment portion **52** can be constituted by the outer edge of the ledge **24g** or have a recessed portion whereby the nut **56** does not protrude from the ledge. It is noticed that the fattener engaging portion is now in the form of a threaded portion **58** of the nut **56**.

Figs. **7A** to **7C** illustrate additional embodiments of the present invention in which an eyeglass assembly and fastening arrangement are designed to further stabilize the assembly against movement, especially against rotation between a clip and a lens. These embodiments can be used with any conventional fastening arrangement, not only those described herein.

Figs. **7A** and **7B** show one of these embodiments wherein a component in the form of a clip **20h** and a lens **10'** comprise inter-engaging parts. For illustrative purposes only, this embodiment is shown in combination with the embodiment of

Fig. **4A**, however all the embodiments shown in Figs. **7A** to **7C** can be used in combination with any of the herein described embodiments.

The clip **20h** has a leg **22b** with an indentation **62** and the lens **10'** comprises a projection **60**, typically an integral part thereof, designed to inter-engage with the clip's indentation to prevent rotation between the clip and the lens about the bore's axis **L1**.

Fig. **7B** provides a section of Fig. **7A** along the line **A-A** for better visualization of the inter-engagement.

One reason contributing to the potential rotation, indicated by arrow **R**, is that the fastening is at one point in the lens **10** – namely at the bore **16**. Another reason is due to the elastic properties of the materials from which clips and/or lenses are made and this may cause loosening of the assembly.

Another embodiment designed to prevent this rotation is shown in Fig. **7C** and uses a similar concept. However, here a lens **10"** comprises a recess **70** which the leg **22** fits therein. The recess **70** is formed and defined by bulges **72** in the contour of the edge of the lens **10"**. Thus, due to inter-engaging parts of the lens **10"** and the clip **20g**, rotation is again prevented, and, since the bulges **72** are external to the normal area of lenses, the clip's leg **22** does not infringe on the field of view.

Lens configurations as described above can be produced by a machine using a production process which obtains the lens's contour in a digital form as disclosed in applicant's U.S. Patent No. 6,607,270. Contours of a lens and their digital presentation can be modified to include the above described configurations and/or other modifications may also be made in the contours, for example, in order to achieve a desired aesthetic effect. The final contours may then be input to a milling machine for shaping the lenses from blanks.

Still an additional embodiment of the present invention will now be described with reference to Fig. **8A** in which the fastening arrangement comprises a fastener in the form of a screw **30d** having a head **32d** with an arm **80** attached thereto.

The arm **80** is used for applying and controlling the torque applied to the screw **30d** and is connected thereto by a neck **82** typically at the center of the screw's head **32d**. The neck **82** is designed to fail at a predetermined torque at which point the arm **80** detaches from the screw **30d** and thus the predetermined torque is applied.

The arm **80** preferably comprises longitudinal flat sections **84** and/or a slot **86** for engagement with a tool (Fig. **8B**) for applying torque such as a wrench or a screw driver, respectively. Such a tool **90**, adapted for engagement with the arm **80**, is also shown and comprises a sleeve **92**, an engaging portion **94** and a grip **96**.

The sleeve **92** fits over the arm **80** to hold it and thereby hold the screw **30d** and so that when the arm detaches from the screw head **32d** it is held therein. The sleeve may further help prevent the tool **90** from slipping there-from upon torquing. The engaging portion **94** is designed to engage with the slot **86**. Alternatively, or in addition to, the sleeve **92** may have and inner surface **98** adapted to correspond to the flat portions **84** of the arm **80**. Further, for ease of use, the sleeve **92** may flare out for easy engagement and positioning on the arm **80**.

While the just-described tool-arm arrangement is applicable to a variety of fasteners and fastening applications, especially for which a predetermined torque is desired, it is particularly useful for the above-describe application since the arm **80** facilitates handle-ability and assembly of small components and essentially precludes accidental damaging (e.g. scratching) lenses.

Further, this arrangement enables fast, exact and reliable fastening of fasteners without the use of particularly skilled labor, and the fastener cannot be accidentally tightened more than the predetermined torque, regardless of the force applied thereto by the assembly-person.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown by the exemplary embodiments described hereinabove. Thus, the fastener assembly and fastening arrangement therefor can be embodied by a variety of aspects within the scope of the invention, *mutatis mutandis*.